

Charging of individual micron-size interstellar/planetary dust grains by secondary electron emissions

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Dust grains in various astrophysical environments are generally charged electrostatically by photoelectric emissions with UV/X-ray radiation, as well as by electron/ion impact. Knowledge of physical and optical properties of individual dust grains is required for understanding of the physical and dynamical processes in space environments and the role of dust in formation of stellar and planetary systems. In this paper, we discuss experimental results on dust charging by electron impact, where low energy electrons are scattered or stick to the dust grains, thereby charging the dust grains negatively, and at sufficiently high energies the incident electrons penetrate the grain leading to excitation and emission of electrons referred to as secondary electron emission (SEE).

Currently, very limited experimental data are available for charging of individual micron-size dust grains, particularly by low energy electron impact. Available theoretical models based on the Sternglass equation (Sternglass, 1954) are applicable for neutral, planar, and bulk surfaces only. However, charging properties of individual micron-size dust grains are expected to be different from the values measured on bulk materials.

Our recent experimental results on individual, positively charged, micron-size lunar dust grains levitated in an electrodynamic balance facility (at NASA-MSFC) indicate that the SEE by electron impact is a complex process. The electron impact may lead to charging or discharging of dust grains depending upon the grain size, surface potential, electron energy, electron flux, grain composition, and configuration (e.g. Abbas et al, 2010). Here we discuss the complex nature of SEE charging properties of individual micron-size lunar dust grains and silica microspheres.

References:

Abbas M. M. et al. (2010) *ApJ*, 718, 795–809.

Sternglass, E. J. 1954, The theory of secondary electron emission, Sci/Pap, 1772, Westinghouse Lab., Pittsburgh, PA